Subject Description Form

Subject Code	AAE6103
Subject Title	Advanced Control Theory for Aircraft
Credit Value	3
Level	6
Pre-requisite/ Co-requisite/ Exclusion	N/A
Objectives	To provide students with theories of advanced flight control including linear and nonlinear analysis and control methodologies, backstepping, feedback linearization, sliding mode control, adaptive control.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a) possess the essential knowledge and skills in advanced flight control theories. b) design flight controllers which can deal with real-life model uncertainties or disturbances. c) analyze the closed-loop stability of the designed flight controller. d) apply the advanced control theories to control the aircraft.
Subject Synopsis/ Indicative Syllabus	**Introduction of Flight control –** nonlinearities, model uncertainties, wind disturbances. **Linear control and analysis –** state-space representation, state-space solutions, stability, controllability, observability, state feedback design, output feedback design. **Nonlinear control and analysis –** Lyapunov's indirect and direct methods, invariant set theorem, Barbalat's lemma. **Backstepping** – stabilization by backstepping. **Input-output linearization** – asymptotic tracking by input-output linearization, normal form and zero dynamics. **Sliding control** – sliding surface, disturbance rejection, robustness. **Adaptive control** – adaptive control for aircrafts, adaptive control for Euler-Lagrange systems.

Teaching/Learning Methodology

1. The teaching and learning methods include lecture/tutorial sessions, homework assignments and mini project.

2. Scientific examples and problems are raised and discussed in class/tutorial sessions.

Teaching/Learning Methodology	**Intended subject learning outcomes**			
	a	b	c	d
1. Lecture/Tutorial	√	√	√	√
2. Homework assignment	√	√	√	√
3. Mini project	√	√	√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Homework assignment	20%	√	√	√	√
2. In-class test	30%	√	√	√	√
3. Final examination	50%	√	√	√	√
Total	100 %				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:

0.5 x End of Subject Examination + 0.5 x Continuous Assessment

The continuous assessment consists of two components: homework assignments and an in-class test. Homework assignments are aimed at evaluating the progress of students' study, assisting them in self-monitoring of fulfilling the respective subject learning outcomes, and enhancing the integration of the knowledge learned. The in-class test serves to evaluate the students' capability of analyze the performance of complex aircraft systems using linear control technique, Lyapunov and Lyapunov-like methodologies.

The final examination is used to assess the knowledge acquired by the students for understanding, analyzing, and solving the control problems of aircraft systems critically and independently; as well as to determine the degree of achieving the subject learning outcomes.

Student Study Effort Expected	Class contact:	
	▪ Lecture	39 Hrs.
	Other student study effort:	
	▪ Literature Review and Self-learning	30 Hrs.
	▪ Assignments	30 Hrs.
	▪ Software design (take home exercises)	12 Hrs.
	Total student study effort	111 Hrs.
Reading List and References	1. H. K. Khalil, *Nonlinear Systems*. 2002, Third Edition 2. J.J. Slotine and W. Li, *Applied Nonlinear Control*, Prentice Hall Englewood Cliffs, 1991. 3. C.-T. Chen, *Linear Systems Theory and Analysis (3rd Edition)*, Oxford University Press, 1999. 4. E. Shtessel, Y., Edwards, C., Fridman, L., Levant, A., *Sliding Mode Control and Oservation*. 2014: Springer, Latest Edition 5. Mclean, D. *Automatic Flight Control Systems*, Prentice Hall International, Latest Edition.	

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